

Original

Knowledge and perceptions of hydration: a survey among adults in the United Kingdom, France and Spain

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Abstract

Rationale: Proper hydration is critical to human health and wellbeing. Currently, little is known about the knowledge, attitudes and beliefs regarding hydration among the general adult population. A survey was conducted to explore some of the misunderstanding around hydration.

Methods: A web-based survey was designed to elicit information about knowledge and understanding of hydration, dehydration and overhydration. The structured questionnaire took approximately 10 minutes to complete. Descriptive statistics are presented.

Results: 3,000 adults (18–65 years) completed the survey (1,000 adults/country in United Kingdom, France and Spain). Overall, 43% and 33% of the sample did not know adequate daily intake of water for men and women, respectively. The majority of participants incorrectly believed that everyone should drink eight glasses of plain water each day (78%). Urine colour was the most recognised indicator of proper hydration (85%) and 81% of the sample recognised tiredness as symptom of dehydration. Knowledge of the symptoms of overhydration was poor with < 50% of participants able to identify common symptoms.

Conclusions: Given the implications for public health, knowledge among the general adult population should be improved with regard to awareness of adequate water intakes, dietary sources of water, symptoms of dehydration and overhydration.

Key words: Hydration. Dehydration. Water intake.

CONOCIMIENTO Y PERCEPCIONES EN RELACIÓN A LA HIDRATACIÓN: ENCUESTA ENTRE POBLACIÓN ADULTA EN REINO UNIDO, FRANCIA Y ESPAÑA

Resumen

Justificación: Una hidratación adecuada es fundamental para la salud y el bienestar. Actualmente se sabe poco sobre los conocimientos, actitudes y creencias de la población adulta con respecto a la hidratación en general. Por este motivo, se realizó una encuesta para explorar algunos de los malentendidos en torno a la hidratación.

Método: Se realizó un estudio sociológico on line para obtener información sobre el conocimiento y la comprensión de la población general en relación a conceptos relacionados con hidratación, deshidratación y sobrehidratación. El cuestionario estructurado tenía una duración aproximada de 10 minutos. Se presentan las estadísticas descriptivas.

Resultados: 3.000 adultos (18–65 años) completaron la encuesta (1.000 adultos por país, incluyendo Reino Unido, Francia y España). En general, el 43% y el 33% de la muestra no conocían las cifras de ingesta diaria adecuada de agua para hombres y mujeres, respectivamente. La mayoría de los participantes creía erróneamente que cualquier persona debe beber ocho vasos de agua al día (78%). El color de la orina fue el indicador más reconocido de una hidratación adecuada (85%) y el 81% de la muestra conocía que el cansancio puede ser un síntoma de deshidratación. El conocimiento de los síntomas de la sobrehidratación era limitado, con menos del 50% de los participantes capaces de identificar los síntomas más comunes.

Conclusiones: Teniendo en cuenta las implicaciones para la salud pública, el conocimiento entre la población adulta en general debe ser mejorados con respecto a la conciencia de las tomas de agua adecuadas, las fuentes de agua en la dieta y los síntomas de la deshidratación y la sobrehidratación.

Palabras clave: Hidratación. Deshidratación. Ingesta de agua.

Introduction

Water is critical for the health, wellbeing and normal functioning of the human body and may also play a role in

disease prevention and health promotion^{1,2}. Water constitutes approximately 50–60% of the normal adult body mass, a proportion that is tightly regulated, varying by no more than 1% body weight on a daily basis³. Homeostatic mechanisms maintain the balance between output via excretory pathways (principally the kidneys) and intake by stimulating thirst. Of the total water consumed, 20–30% typically comes from food and 70–80% from beverages, depending on individual dietary choices⁴.

In addition to homeostatic regulation by the kidneys, water may be lost from the body in a number of ways,

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including respiratory loss, faecal loss and transcutaneous loss. Sweating is the mechanism by which the body cools itself in conditions of heat, humidity and physical activity⁵. When water losses exceed intake, dehydration arises and can result in a range of adverse consequences impairing physical and cognitive performance, cardiac function, and haemodynamic and thermoregulatory responses². Heart rate may increase as the body attempts to maintain blood flow to the tissues and organs even as the blood pressure falls with the decreasing blood volume. Central nervous system effects can range from headache and dizziness associated with mild dehydration to an altered mental state in cases of severe dehydration⁶. Several epidemiological studies have shown that even short periods of very warm weather increase morbidity and mortality, especially in vulnerable populations⁷. There is good epidemiological evidence for an association between chronic hypohydration and an increased risk of a number of disease states, including kidney stones, constipation, coronary heart disease and stroke: there is also some evidence for a link between poor hydration and renal disease, bladder and colorectal cancer, and dental diseases⁸. Overhydration can also arise when water intake exceeds excretion². Chronic mild overhydration is generally regarded as harmless. However, there is evidence that hyponatremia may increase the risk for falls and fractures among the elderly^{9,10}. The mechanism may include a mild cognitive impairment resulting in an unsteady gait and by a direct effect on bone fragility by increasing bone resorption⁹. Acute severe overhydration is a rare condition associated with a large intake of plain water in excess of the body's actual requirements in combination with an electrolyte deficiency (e.g. via high sweat losses) and an inability of the kidneys to compensate with increased urine output. A small number of deaths due to acute severe overhydration are reported each year among marathon runners and those taking part in other long duration sports events and appear to result from a disturbance in the water and electrolyte balance in intracellular spaces resulting in water being drawn into cells causing them to swell. In the brain, this can result in a rise in intracranial pressure which, if unchecked, can result in restricted blood flow, seizures, coma or death^{6,10}.

Previous surveys suggest a reasonable level of understanding of hydration and fluid replacement among defined groups such as collegiate athletes¹¹ and Australian miners. However, despite the critical role of proper hydration in maintaining health and wellbeing^{12,13}, little is known about the knowledge, attitudes and perceptions towards hydration among the general population¹⁴. This survey sought to understand and quantify this knowledge gap by exploring the misunderstandings around hydration.

Methods

An online survey was undertaken in three European countries (UK, France and Spain) to explore current attitudes towards, and beliefs regarding, human hydration.

The study was supported by the European Hydration Institute. The web-based, structured questionnaire took approximately 10 minutes to complete.

Fieldwork was conducted between March 12th and 28th, 2014. Survey participants were recruited using a stratified random sampling from a panel population representative of the country population and using with gender, age and geographical area as strata in order to guarantee representativeness in the UK, France and Spain. Sample distribution of respondents matched population distribution on all pre-defined strata.

The web questionnaire was pilot tested prior to launching the fieldwork to ensure it was properly understandable.

Participants

Participants completed a series of screening questions prior to undertaking the main questionnaire. The screening questions were designed to ensure only eligible participants completed the survey (resident in the UK, France or Spain, and aged from 18 to 65 years), to facilitate stratification and ensure a representative sample by gender, age (18–24 years, 25–34 years, 35–44 years, 45–54 years and 55 to 65 years) and region for each country. Basic demographic information about the survey population (age, gender and highest educational qualification) was also collected via the screening questions.

Survey structure

The main survey consisted of 11 questions (table I) and included items designed to elicit information on attitudes towards and current knowledge relating to human hydration as well as the symptoms of overhydration. The first question asked whether the participant perceived themselves to be sufficiently hydrated. Questions 2 to 4 examined knowledge of adequate water intakes and sources of water in the diet. Questions 5 to 7 asked about symptoms of adequate hydration, dehydration and overhydration. Questions 8 and 9 elicited information on knowledge of hydration during the day and over a lifetime. The final two questions asked about information sources for hydration.

Statistical analysis

Statistical Analysis was conducted using SAS version 7. Descriptive statistics are presented throughout. The sample size of each country allows for a sampling error of $\pm 3.10\%$ assuming maximum uncertainty ($p = q = 0.5$) and confidence level of 95% ($z = 1.96$).

Results

The survey population consisted of 3,000 adults with 1,000 participants from each of the three countries (UK,





Table I
Research questions and answer format

<i>No.</i>	<i>Question text</i>	<i>Answer format</i>
1	Do you think you are sufficiently hydrated?	Yes or No
2	According to the European Food Safety Authority (EFSA) what do you think is the recommended adequate intake of water (in litres per day)?	State variable for men and women
3	The daily recommended intake of water has to come from... <ul style="list-style-type: none"> • Just plain water • Plain water and other beverages • A mix of foods and beverages 	Select single option
4	For an average diet in adults, what percentage of water would you normally expect to come from food and what percentage from beverages? <ul style="list-style-type: none"> • % of water coming from foods • % of water coming from beverages 	State variable foods and beverages
5	Which of these statements may be symptoms of proper hydration in healthy conditions? <ul style="list-style-type: none"> • Normal blood pressure • Clear urine colour • Shiny hair • Normal body temperature • Low urine output • Healthy nails 	Select one or more options
6	Which of these statements may be symptoms of dehydration? <ul style="list-style-type: none"> • Insomnia • Drop in blood pressure • Dizziness • Tiredness • White hair • Brittle nails 	Select one or more options
7	Which of these symptoms may be symptoms of overhydration? <ul style="list-style-type: none"> • Impaired mental focus • Insomnia • Increased body temperature • Brittle nails • Dizziness • Increased bone fragility 	Select one or more options
8	Please carefully read each of the following statements about hydration <i>during different moments throughout the day</i> . Decide whether it is mostly true or mostly false and mark your answer accordingly. <ul style="list-style-type: none"> • During the day everyone should drink eight glasses of plain water • In the winter, you cannot get dehydrated • Caffeinated drinks dehydrate you • At school. Adequate hydration is important for proper brain performance • Dehydration only occurs in specific situations such as high temperatures or after long periods without liquid • At work, dry air due to air-conditioning increases water loss • At lunch, all foods contribute the same to body hydration • When you have intensely exercised more than 1 hour, sport drinks are generally better than just plain water • When you drive, beverages may help to reduce road fatigue • At the beach, good hydration can reduce the risk of heatstroke 	For each statement select true, false or don't know





Table I (cont.)
Research questions and answer format

No.	Question text	Answer format
9	<p>Please carefully read each of the following statements about hydration during different moments in your life. Decide whether it is mostly true or mostly false and mark your answer accordingly.</p> <ul style="list-style-type: none"> • Our percentage of body water content is roughly the same throughout our entire life • During pregnancy and breastfeeding, hydration needs for mothers are higher than during other periods of adult life • Infants and children need water not only to replace daily water losses, but also to grow • In an adult, hydrating is just about water • In an adult, drinking a lot of water is a good way to cleanse the body • In an adult, dehydration is relatively rare and occurs only when the body is deprived of water for several days • In an adult, thirst is an indicator that you may be mildly dehydrated • Strong (distilled) alcoholic beverages may provoke dehydration • Due to age or some medications, the sensation of thirst can be reduced • The risk of dehydration is the same in adults and elderly people 	For each statement select true, false or don't know
10	Do you seek our information about hydration?	Yes or No
11	<p>What are your sources for acquiring hydration information?</p> <ul style="list-style-type: none"> • General practitioner • Specialist • Nurse • Pharmacist • Nutritionist • Dietician • Friends/relatives • Printed books/newspapers/magazines • Television and radio • Internet • Others 	Select one or more options

France and Spain). Table II provides an overview of the demographics of the survey population. Very few participants (12% overall; UK 16%, France 9%, Spain 12%) reported having actively searched for information on hydration. Where information had been sought, the internet was identified as the main source. In all, 29% of the survey population did not consider themselves to be sufficiently hydrated (UK 31%, France 24%, Spain 33%).

General perception about hydration

Awareness of EFSA adequate intakes of water for men (2.5 L/day) and women (2.0 L/day) was not optimal, with 57% of population indicating an amount between 2–3 L/day for men and 66% of population indicating an amount between 2–3 L/day for women). Awareness was lower among the UK and France survey populations (fig. 1). In the UK, 48% of and 50% of the population overestimated adequate water intake for men and women, respectively (responses of > 3 L/day for men and > 2.5 L/day for women). The French survey population tended

to underestimate adequate water intake for men (43% of participants responded < 2 L/day).

Overall, 23% of participants incorrectly indicated that the recommended origin of water is just from plain water (UK 25%, France 22%, Spain 21%). Around half (54%) of respondents correctly identified a mix of foods and beverages as the recommended source of water (UK 43%, France 59%, Spain 59%).

In an average diet, approximately 20–30% of daily water intake would be obtained from foods and 70–80% from beverages (EFSA 2010). Overall, half (50%) of the survey population correctly provided responses within these ranges. In the UK 46% of the survey population correctly responded within these ranges compared with 50% in France and 53% in Spain.

Knowledge about hydration, dehydration and overhydration

Table III provides a summary of response on awareness of proper hydration and symptoms of dehydration and overhydration among the survey population.





Table II
Demographics of the survey population

	UK (N = 1,000)		France (N = 1,000)		Spain (N = 1,000)	
Gender (%)						
- Male	49		49		49	
- Female	51		51		51	
Age group (%)						
- 18–24 years	14.7		17.1		16.2	
- 25–34 years	20.2		19.6		25.9	
- 35–44 years	23.5		22.1		23.6	
- 45–54 years	22.6		21.5		19.0	
- 55–65 years	19.0		19.7		15.3	
Highest level of education (%)						
- GCSE/O level		24.0	- CEP,CAP	9.2	- Primary	2.6
- A level		23.2	- BEPC, BEP	9.3	- Secondary	42.3
- University degree		33.6	- Baccalaureat	26.3	- University	41.8
- Higher degree		8.6	- BTS, DUT	23.2	- Higher degree	12.6
- NVQ		10.6	- Other diploma	31.5	- No response	0.7
			- No response	0.4		
Region (%)						
- Central London		8.5	- East	8.6	- Andalucía	17.8
- East Midlands		7.1	- Sud Ouest	10.9	- Aragón	2.9
- East of England		9.5	- Sud Est	12.0	- Asturias	2.5
- Greater London		7.0	- Bassin Parisien Ouest	9.4	- Balears	2.2
- North East		4.3	- Bassin Parisien Est	7.8	- País Vasco	4.9
- North West		11.5	- Ouest	13–5	- Canarias	4.4
- Northern Ireland		2.0	- Méditerranée	12–5	- Cantabria	1.3
- Scotland		8.0	- Paris, region parisienne	18.8	- Castilla-La Mancha	4.3
- South East		11.4	- Nord	6.5	- Castilla-León	5.8
- South West		8.2			- Cataluña	15.8
- Wales		5.0			- Extremadura	2.4
- West Midlands		8.8			- Galicia	6.4
- Yorkshire and the Humber		8.7			- Madrid	13.7
					- Murcia	3.0
					- Navarra	1.4
					- Rioja	0.7
					- Comunidad Valenciana	10.5

UK: GCSE, general certificate of education.

France: CEP (Certificat d'études primaires), CAP (Certificat d'aptitude professionnelle), BEPC (Brevet d'Etudes du Premier Cycle), BEP (Brevet d'études professionnelle); BTS, [Brevet de technicien supérieur], DUT Diplôme universitaire de technologie).

The majority of the study population (85%) correctly identified clear urine colour as an indicator of proper hydration. However, normal body temperature was only identified by 60% and normal blood pressure by 56% of the study population. Healthy nails and shiny hair were incorrectly identified as indicators of proper hydration by 41% and 35% of the survey population, respectively. The results for each country were broadly similar. Notable differences included a considerably higher proportion of participants from Spain incorrectly considering shiny hair to be an indicator of proper hydration compared with participants in France (41% and 25%, respectively).

The study population was well informed about the symptoms of dehydration, showing that 84% correctly identified tiredness, 79% identified dizziness and 54% identified a drop in blood pressure as symptoms of dehydration. Brittle nails and insomnia were incorrectly identified as symptoms of dehydration by 38% and 28% of the survey population, respectively. In Spain, 23% of

participants did not identify tiredness as a symptom of dehydration compared with 19% of participants in France and 14% of those in the UK. Dizziness was not considered a symptom of dehydration by 28% of participants in France compared with 20% of those in Spain and 17% of those in the UK. A greater proportion of participants in Spain (63%) correctly identified a drop in blood pressure as a symptom of dehydration compared with 50% of those in the UK and 50% of those in France.

The survey population was less well informed regarding the symptoms of overhydration. Overall, 42% of participants correctly identified impaired mental focus, 39% dizziness and 20% increased bone fragility as symptoms of overhydration. Increased body temperature and insomnia were incorrectly identified as symptoms of overhydration by 32% and 30% of the survey population, respectively. Almost two-thirds of participants in France (65%) did not identify impaired mental focus as a symptom of overhydration compared with 50% in the UK and 58% in France. The proportion of participants



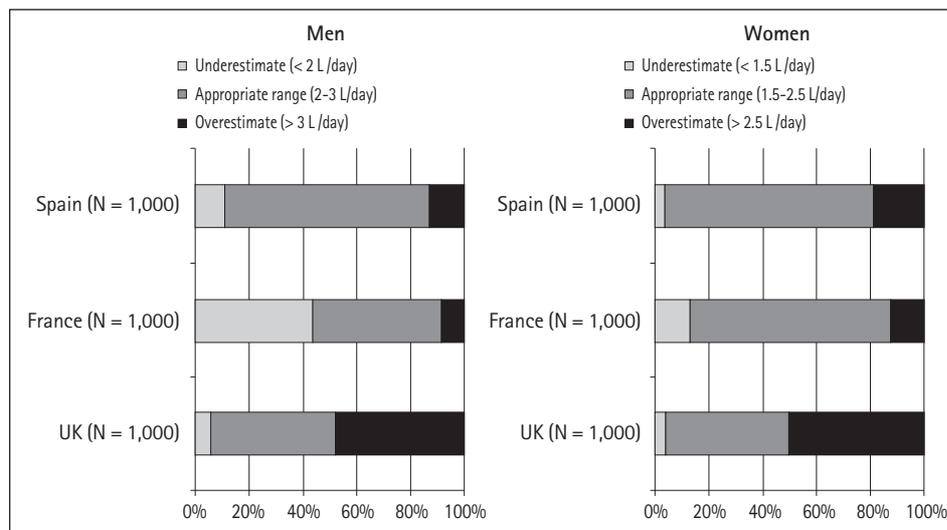


Fig. 1.—Knowledge of recommended adequate intake of water (EFSA) in men and women (participant were asked to specify a volume in L/day).

Table III
Knowledge about indicators of proper hydration and symptoms of dehydration and overhydration among 3,000 adults in the UK, France and Spain

	All (N = 3,000)	UK (N = 1,000)	France (N = 1,000)	Spain (N = 1,000)
Indicators of proper hydration				
Correctly identified as indicators				
- Clear urine colour	84.6	87.0	83.9	83.0
- Normal body temperature	60.2	60.3	62.2	58.0
- Normal blood pressure	56.0	56.6	51.9	59.6
Incorrectly identified as indicators				
- Healthy nails	41.0	43.8	38.6	40.4
- Shiny hair	34.5	37.7	24.5	41.4
- Low urine output	5.2	7.9	4.1	3.6
Symptoms of dehydration				
Correctly identified as symptoms				
- Tiredness	81.4	85.7	81.3	77.2
- Dizziness	78.6	83.5	71.7	80.7
- Drop in blood pressure	54.5	50.3	50.1	63.0
Incorrectly identified as symptoms				
- Brittle nails	38.2	38.6	36.1	40.0
- Insomnia	27.8	30.8	25.3	27.2
- White hair	6.9	7.3	5.9	7.5
Symptoms of overhydration				
Correctly identified as symptoms				
- Impaired mental focus	42.3	50.2	34.8	41.8
- Dizziness	38.8	38.7	37.3	40.3
- Increased bone fragility	19.6	14.8	26.7	17.3
Incorrectly identified as symptoms				
- Increased body temperature	31.5	33.7	30.5	30.3
- Insomnia	30.3	28.8	31.5	30.6
- Brittle nails	8.7	5.0	13.9	7.1

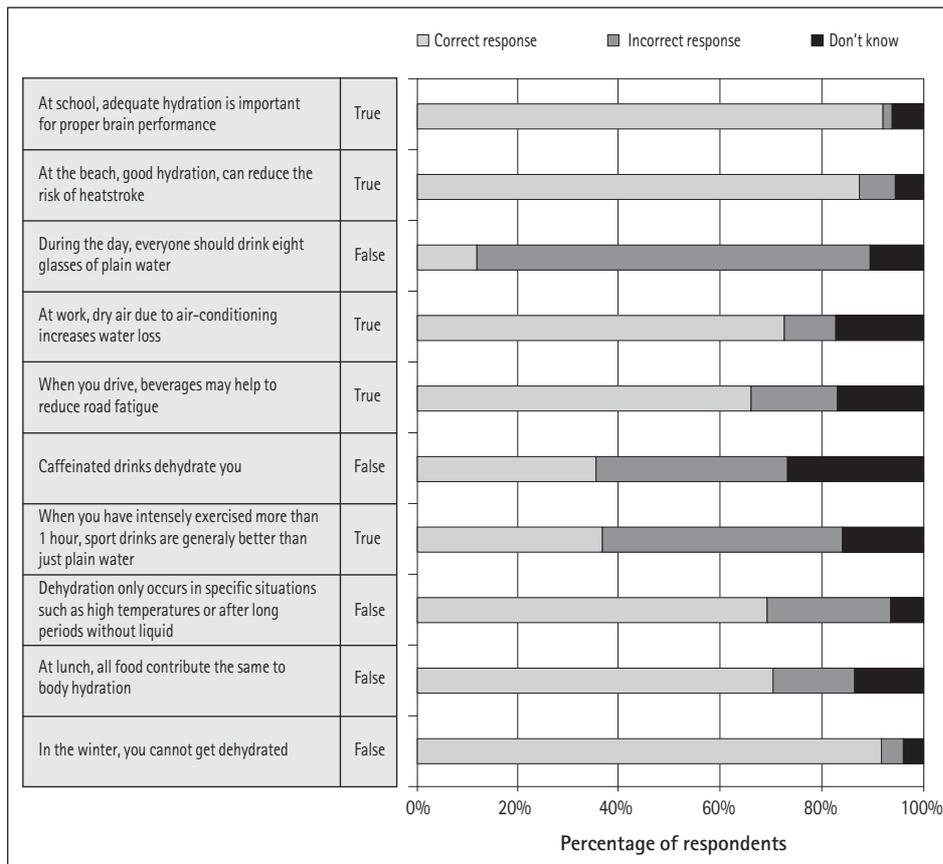


Fig. 2.—Knowledge about hydration throughout the day among 3,000 adults in the UK, France and Spain.

who recognised bone fragility as a symptom on overhydration was low in all countries, 15% in the UK, 27% in France and 17% in Spain.

Knowledge about hydration throughout the day

Figure 2 illustrates the knowledge about hydration throughout the day. Participants were generally well informed with regard to the importance of hydration in relation health and performance in daily life. Only 12% of respondents overall correctly identified the statement *During the day, everyone should drink eight glasses of plain water* as false (UK 16%, France 10%, Spain 11%). There was also an apparent lack of understanding about the dehydrating effects of caffeinated drinks (38% of participants incorrectly identified this as being true) and of the beneficial effects of sport drinks compared with plain water after prolonged periods of exercise (47% of respondents incorrectly disagreed with the statement that *When you have intensely exercised more than 1 hour, sport drinks are generally better than just plain water*). Other notable differences between countries were an apparent lack of understanding of the importance of proper hydration while driving in France with only 44% of participants agreeing with the statement *When you drive, beverages may help to reduce road fatigue* compared with 74% of those in the UK and 82%

of those in Spain and a considerably higher incorrect belief that caffeinated drinks increase dehydration among the UK cohort (59%) compared with 31% in France and 24% in Spain. Recognition of the benefits of sports drinks compared with plain water following prolonged exercise was highest among participants from Spain (48%) compared with 28% of those in the UK and 36% of those in France.

Knowledge about hydration during a lifetime

Figure 3 illustrates knowledge about hydration during a lifetime. The risks of overhydration were apparently widely underestimated with 79% of participants incorrectly agreeing with the statement *In an adult, drinking a lot of water is a good way to cleanse the body*. A smaller proportion of participants in France (70%) recognised the effect of strong alcoholic beverages on dehydration compared with those in the UK (84%) and Spain (75%). A higher proportion of the participants in France correctly (81%) recognised that thirst is not always a reliable indicator of dehydration compared with those in the UK (60%) and Spain (67%). More than twice the proportion of participants in the UK (31%) failed to recognise the increased risk of dehydration in the elderly versus adults compared with participants in France (12%) or Spain (13%).

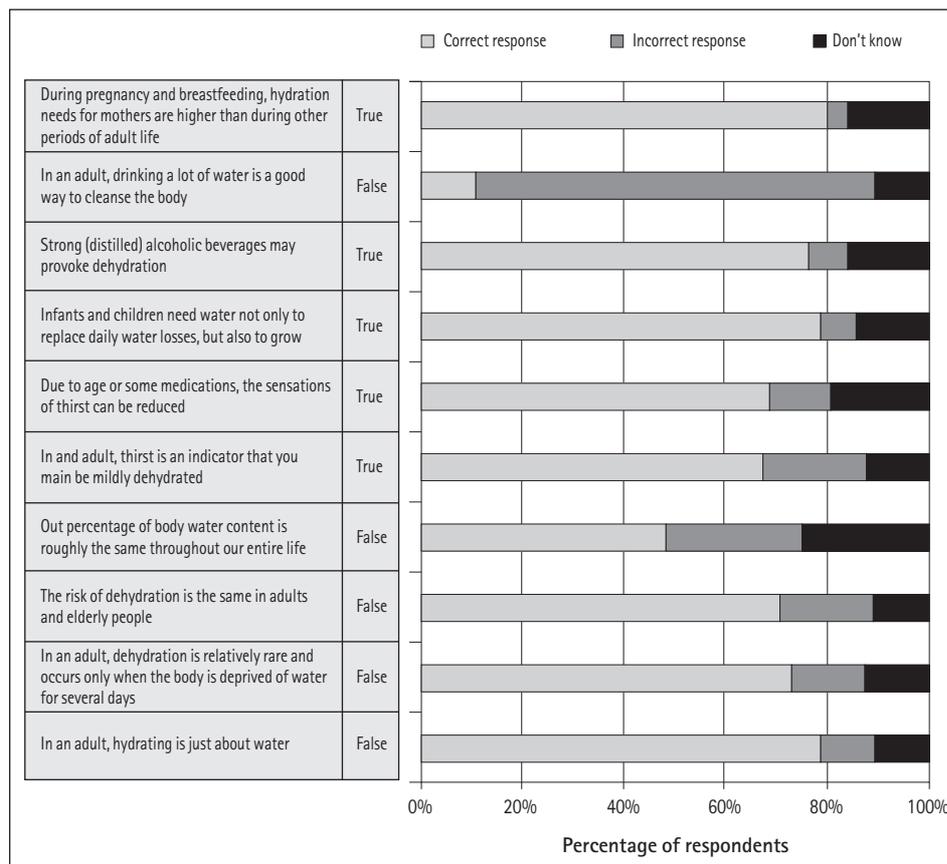


Fig.3.—Knowledge about hydration during a lifetime among 3,000 adults in the UK, France and Spain.

Discussion

The results of this survey have revealed a number of important misconceptions among the adult population of three European countries (UK, France and Spain). Knowledge of adequate water intake values was poor. The majority of participants incorrectly believed that everyone should drink eight glasses of plain water each day. In fact, around 20–30% of dietary water would come from solid foods and 70–80% from beverages including plain water¹². Consistent with a previous study in Australian miners¹⁵, participants in the current survey incorrectly perceived caffeinated drinks to be dehydrating.

Thirst is the body's main regulatory mechanism to stimulate fluid intake in order to maintain proper hydration. It is therefore important that individuals are able to recognise their own hydration status as well as symptoms of dehydration and overhydration. Clear urine colour was correctly identified as an indicator of proper hydration by the majority (85%) of the survey population while normal body temperature and blood pressure were less widely recognised (60% and 56%, of the survey population, respectively). Consistent with this, a drop in blood pressure was not widely regarded as an indicator of dehydration with only 54% of the study population correctly identifying this as a symptom.

The symptoms associated with overhydration were not widely recognised in this large cohort of adults. Only

42% of participants correctly identified impaired mental focus, 39% dizziness and 20% increased bone fragility as symptoms of overhydration. Humans can, by conscious effort, over-ride many of the signals that drive the regulatory processes involved in water balance². Thirst tells us that we should drink but we can choose not to do so. Likewise, we can drink when not at all thirsty. Occasionally, however, the regulatory processes may fail, leading to serious disturbances of water homeostasis. This failure may result in a chronic overhydration which may be relatively benign although it may increase the risk for falls and fractures in the elderly or, in rare cases, acute, severe and life-threatening. The latter is largely limited to situations of prolonged exercise where large volumes of water are taken in and the kidneys are unable to compensate with increased urine output.

To our knowledge, the results presented here represent the first systematic evaluation of the attitudes, perceptions and beliefs about human hydration among the general adult population in Europe. Previous studies on this topic have been conducted with far smaller samples and sport-related populations^{5,16,17,18,19} or in specific general population targets such as mothers of small children²⁰ or in healthcare professionals¹³. In the USA, data on attitudes towards hydration has been reported based on the National Cancer Institute's 2007 Food Attitudes and Behaviours Survey showing that low drinking water intake was associated with age, region of



residence and several unhealthy behaviours and attitudes. Understanding attitudes, perceptions and beliefs about hydration can help, therefore, to design intervention programs to improve hydration status of adult population.

A web-based approach was taken to administer the survey to avoid issues related to accessibility and promote geographical representativeness of the survey population. While, this may also have excluded participants without access to the internet, the number of individuals likely to have been excluded in this way was felt to be small in the three western European countries selected for participation where internet penetration was estimated to be 84% in the UK, 80% in France and 67% in Spain in 2012²¹. Older adults were excluded from the current analysis and future research should seek to understand the knowledge, perceptions and beliefs of individuals over 65 years particularly given that thirst perception and renal function may change with age placing older adults at increased risk for dehydration and overhydration².

The results of this survey have identified a number of areas where knowledge could be improved, including awareness of adequate daily water intakes and sources of water, indicators of dehydration beyond the appearance of urine and the risks and indicators of overhydration. Future educational programmes should seek to improve knowledge in these areas.

Conflict of interests

Authors work for or in relation to the sponsor of the study, the European Hydration Institute.

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